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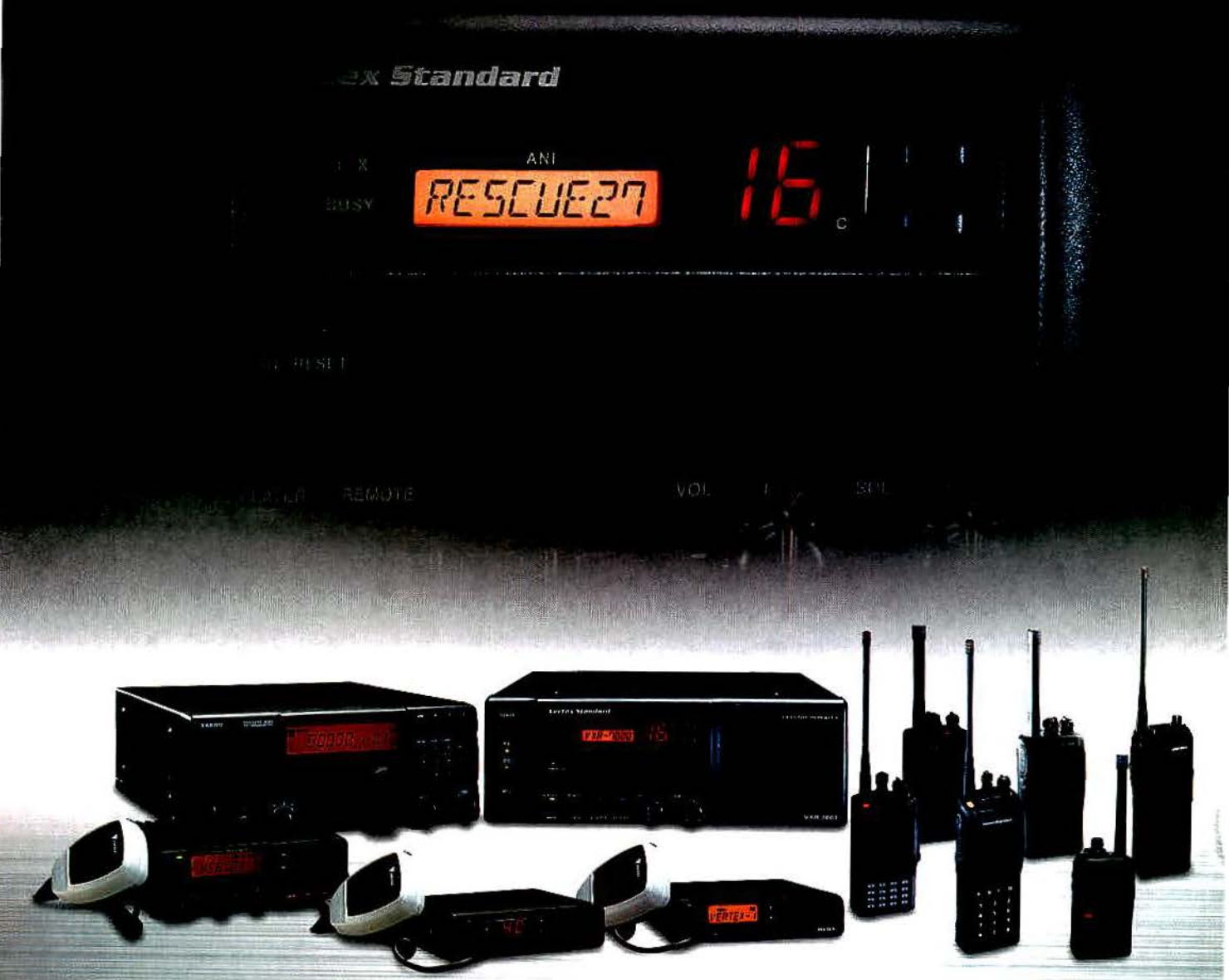

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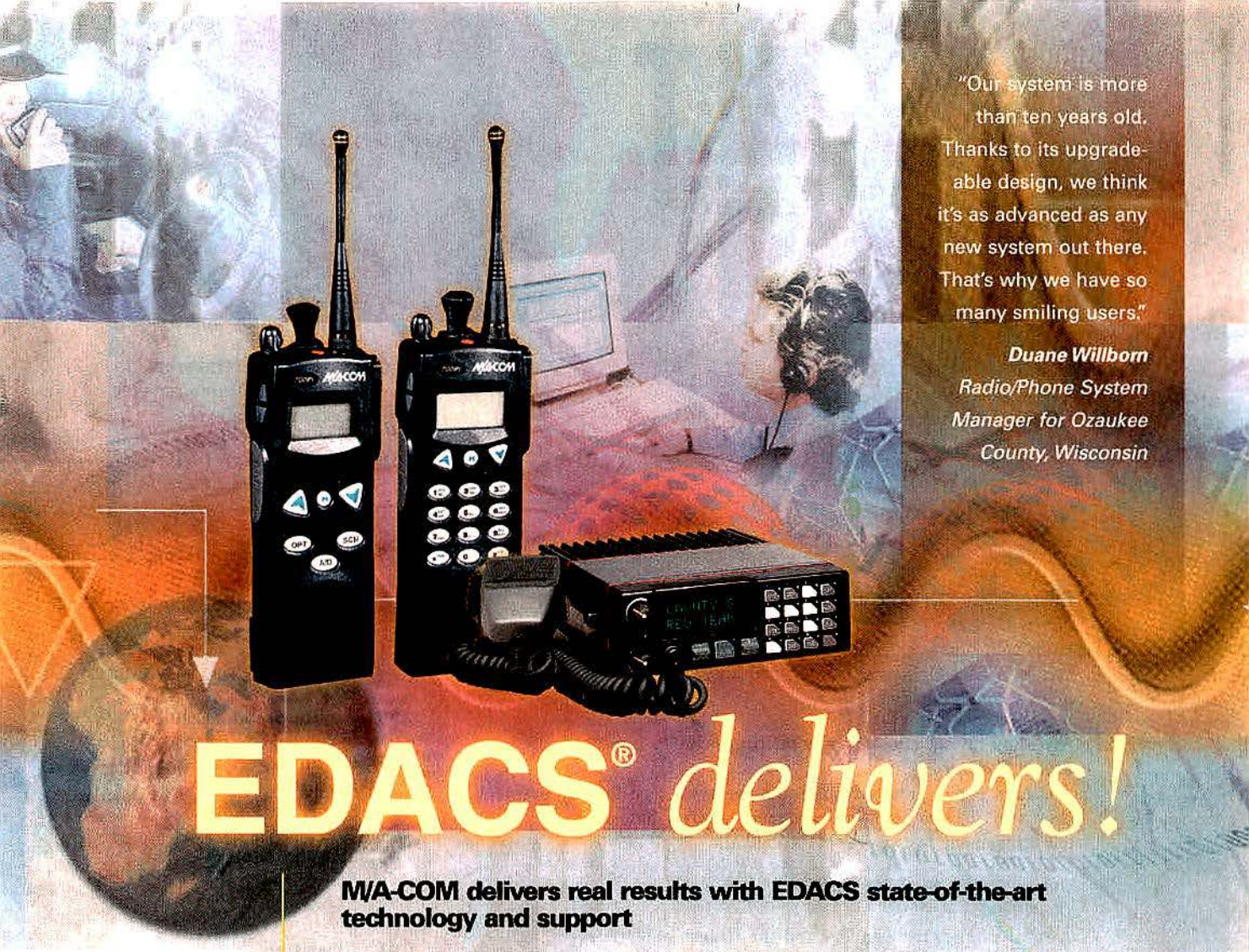

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CIRCLE (4) ON FAST FACT CARD

On the cover: Were public safety officials prepared for the Winter Olympics? See page 22.

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MAY 2002
Volume 20, Issue 5

Features

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IWCELIVE!
Link to news coverage of the 2002 International Wireless Communications Expo. Highlights include product announcements, breaking news, show highlights and industry insights.

PCIA changes recall NABER, with focus on private radio, towers
A slimmed-down Personal Communications Industry Association has shed its annual GlobalXChange trade show, its Global Initiative service, its LifePage program and 14 employees.

Departments

One West Coast carrier completed a Phase II wireless E9-1-1 installation shortly after the FCC's original deadline. See page 30.

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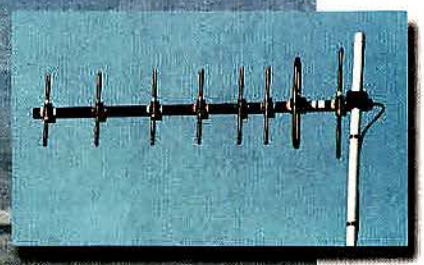

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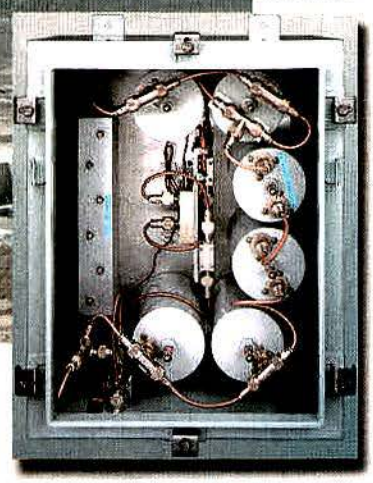

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CIRCLE (5) ON FAST FACT CARD

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See you in the funny papers

The extraordinary effort expended by so many to submit comments to the FCC regarding the resolution of 800MHz interference should not be personified with comic strip characters.

But here goes.

There's the Invisible Man, Nextel Communications, saying, "If you can't see me, you can't touch me." Nextel says isn't responsible for interference caused to 800MHz radio systems that it doesn't own because it is operating within its license terms—oh, most of the time. It doesn't even mention its statutory obligation to avoid causing harmful interference regardless of its license terms. *Poof.* Invisible.

But the Invisible Man doesn't hesitate to claim a statutory obligation for others: "Preserving inefficient, high-site analog *non-public safety* land mobile systems at the expense of spectrally efficient technologies and services would contravene the Commission's statutory obligations," Nextel admonishes the FCC. That's the same FCC that, um, preserves high-site analog *TV* systems at the expense of blah, blah, blah.

There's Superman, the utilities—*ahem*—the *critical infrastructure industries* that use 800MHz radio systems that might be displaced if the Invisible Man gets its way and that might continue to receive interference if it doesn't. The utilities were quick to reach for the yellow "S" and wrap themselves in an indestructible red cape in hopes of avoiding the possible fate of their private wireless brothers.

Mind the cape

Superman says: "See here where it says, oh, for the purposes of spectrum auction exemptions, that 'public safety radio services' include 'private internal radio services that are used by ... non-government entities ... to protect the safety of life, health or property ... and that are not made commercially available to the public'? See that? *That's us. We're public safety.*

You mustn't cause us interference; you mustn't make us pay to change frequencies; and you mustn't otherwise step on our cape."

Don't forget Little Orphan Annie: Southern Linc. Sure, Annie's digital, Annie's a commercial wireless carrier, and Annie looks somewhat like Nextel. But Southern Linc took pains to point out that it hasn't been the subject of interference complaints, it serves five electric utilities *and* 30,000 users among 3,000 public safety agencies. *It* shouldn't be pushed out of the 800MHz band by the Invisible Man just because Nextel won't recognize its own obligation not to cause interference.

Annie says that the FCC should first make *more* rules to require licensees to resolve interference they cause to public safety radio systems. They could use technical adjustments and frequency swaps, but whatever they do, if it doesn't satisfy, arbitration and then perhaps FCC enforcement action should follow. Second, Southern Linc wants all public safety licensees to eventually vacate 800MHz for new housing in the 700MHz band.

Captain Industry, in the form of the Private Wireless Coalition of various private system users and trade associations, likes the idea of public safety moving to 700MHz, but it absolutely, positively won't move to 900MHz. "There's not enough spectrum there to meet our needs," the captain says. The coalition doesn't think there's enough political support for the 700MHz idea, anyway, so it offered up a plan to consolidate 800MHz frequencies used by private systems, public safety and Nextel.

Long green

The Green Hornet, public safety, is green because it's the color of money. Public safety already took a taste of Nextel's money, $25 million, and it can't take its eyes off of the $500 million that it looks as though Nextel has promised the Hornet if he backs Nextel's 800MHz plan. And the Invisible Man promises the Hornet more 800MHz spectrum, too. Forget the utilities, other non-interfering digital system operators and private wireless. Keep your eye on the prize.

The comments filed with the FCC aren't as simple as this editorial makes them out to be. They run more than 1,000 pages, but probably no more than 3,000, counting attachments.

What's unfortunate is that, despite hard work to keep non-public safety land mobile radio united, the industry split into factions as it sometimes does.

Don Bishop

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CIRCLE (6) ON FAST FACT CARD

Battling bat wings

By Robert H. Schwaninger Jr.

The hue and cry about the Nextel White Paper has turned to the more studied approach contained within the FCC's Notice of Proposed Rulemaking (NPRM) (WT Docket 02-55) and what the private radio industry is going to do to answer the agency's questions. And there are questions. The thing has more question marks than periods ... period.

Illustration by John Hayes

What strikes me about the dozens upon dozens of questions and issues raised within the NPRM isn't what was asked, but what wasn't asked. Do I want to comment on the lack of garb of the radio emperor or simply ignore the all-too-obvious naked truth?

Connecting some of those dots that appear obvious to everyone except for the commissioners, have we noticed that the greatest level of interference within the 800MHz band appears to be between Motorola-made public safety equipment and Motorola-made Nextel equipment?

Now, you might wish to point out that Motorola has many divisions and vice presidents and people who are trying to explain what the Iridium deal was all about, and that these divisions might not talk to one another. It may be that the public safety side of the house *doesn't* associate with the IDEN people. But maybe they should.

Maybe before public safety equipment was sold to local governments over the last five to seven years, Motorola should have read the reams of comments filed before the FCC by nearly every corner of the private radio industry, which pointed out that the digital signals produced by IDEN operations were going to create real problems for analog operators. Then, maybe one blue bat wing wouldn't be beating against another in the marketplace.

So, one question that wasn't asked in the NPRM is whether Motorola should be stepping up to pony up some of the fix-it money. The NPRM focuses on the duties of CMRS operators, digital operators, analog equipment manufacturers (in general), public safety entities, Congress, cellular operators, and just about everyone even remotely associated with the interference issue. Somehow, the document does not note that the problem is, on one level, internal to Motorola.

That Motorola is still one of Nextel's largest stockholders places it even more squarely in the middle. That Motorola has been the third-party contractor for relocating SMR operators again nudges its business plans into the spotlight.

As anyone who has read this column with any frequency knows, I am not a Nextel apologist. There are those people who have criticized me as seeming to have an obsession about the machinations of the FCC-Nextel connection and the mischief that has been wrought on our industry in the name of emerging technologies. In this case, maybe we should look beyond Nextel and Mr. McCaw and more closely at the one entity that was positioned to avoid the severity of the interference problem and that chose, instead, to sell radios.

While we are in a mood to examine the root causes of the problem, let us venture even further into the world of honest assessment. Come on in. There's plenty of room because it's a place that more diplomatic persons rarely enter and often studiously avoid. But don't be afraid. It's just the truth, and who can that hurt?

Literally hundreds of people have repeated again and again via comments, organizational efforts, articles and technical studies that the introduction of low-site, digital operations into an analog environment, absent adequate filtering, would create harmful interference. The industry publications have stated it. The representatives of every private radio group have stated it. And every technical organization from the IEEE to the ham radio operator wing of the Pella, Iowa Moose Lodge has stated it. So, why didn't the FCC listen?

We sometimes forget that the FCC is the "expert agency" for the purpose of regulating telecommunications, not making systems work. And when the job of regulation is performed moreover for the purpose of raising money via auction dollars or promoting industry consolidation in the name of emerging technologies—giving a

Schwaninger, *MRT's* regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a fellow of the Radio Club of America. His email address is *rschwaninger@sa-lawyers.net.*


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CIRCLE (7) ON FAST FACT CARD

boost for a particular political platform—the agency's experts turn first to listen to the robber barons, and last to the technicians—if at all.

My wife accuses me of selective hearing. I can hear a ball score whispered across a radio speaker that is partially covered by a sweatshirt. I can't hear her ask me to take the trash out. And I'm the "expert husband agency" in our home. So, I get it. When the FCC is awash in the din of clinking cash registers and blinded by a blizzard of hanging chads, it has trouble focusing on practical applications of technical knowledge.

So, if we are honest, the problems that public safety operators (and all others working in 800MHz analog) are presently suffering may also be laid at the feet of the agency. The FCC was told that its regulatory scheme would cause problems. The agency was informed of the difficulties and was witness to the rising number of incidents of harmful interference that began to spring up and spread like crab grass across the lawn of short-sighted laws that reconfigured the use of the 800MHz band.

I am pleased that the FCC is demonstrating some interest in this area for the sake of the beleaguered public safety operators. I am further willing to give a nod of approval for the FCC not lofting the Nextel White Paper as the sole solution (or even the best solution) for dealing with the problem. But what distresses me is that the agency is searching outside of its own house for solutions and financing. What further distresses me is that proposed solutions might easily benefit Motorola.

So, we are back to asking the unasked questions. Why not solve the problem by having Motorola and the FCC pay for their combined past mistakes? And why does the NPRM lack the one honest statement that would show the compassion and caring and public spirit that Sept. 11, 2001, was supposed to offer in exchange for the horror—an apology to public safety from Reed Hundt. ■

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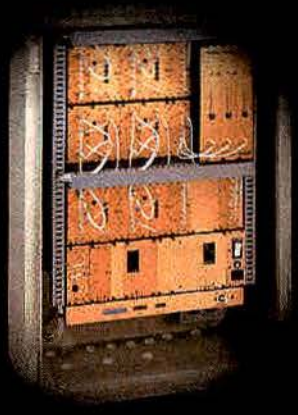

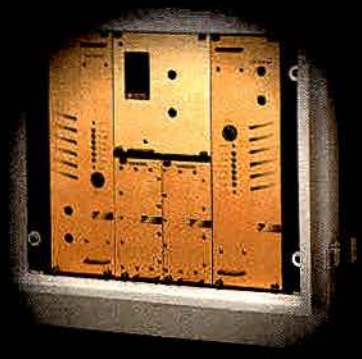

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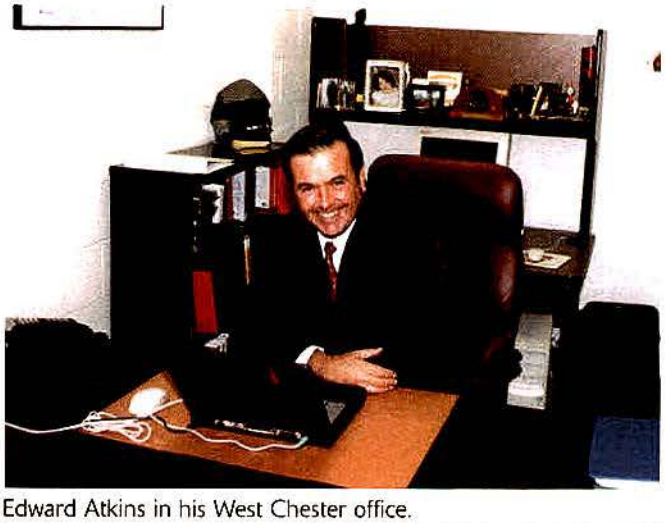
CIRCLE (8) ON FAST FACT CARD

Remember the basics

Learn from one county's experiences expanding an emergency services radio system.

By Edward J. Atkins

Chester County in southeastern Pennsylvania is in the final stages of transitioning to an E. F. Johnson 800MHz Multi-Net emergency services voice radio system. Although the county's integrated emergency communications architecture has other important systems, the voice radio has been the most visible.



Edward Atkins in his West Chester office.

Here are some observations (from my experience) that may be useful to others about to embark on such an endeavor.

Vision, goals and objectives

It was important to remember what we were trying to do. Fundamentally, the county required a voice radio system with coverage in additional areas, less interference than the existing VHF radios, and compatibility with other parts of an integrated communications system that could accommodate growth.

We needed to guard against the "capability creep" from various quarters—however well-intentioned—recommending additional features that, although laudable, exceeded the project vision and design goals. Rather than simply dismiss these ideas, we have kept a catalog and will conduct an appropriate cost vs. benefit analysis later to determine what additional features are appropriate.

Customer focus

With the emphasis on quality in the past few years, customer focus might seem too obvious to mention. Customer focus is especially important in a county communications center where independent customers include 44 municipal police departments, 57 fire departments and 27 emergency medical service organizations.

When thinking of customers for the radio system, don't forget the dispatchers on the other end of the line to emergency responders in the field. Our customers—the field responders and the dispatchers—are the teams that ensure that citizens in distress get appropriate help quickly and efficiently. Our customers have many critical tasks to perform, sometimes under stressful conditions. Their loud-and-clear message to us was that effective, reliable, clear and easy-to-use communications tools are critical to their safety and success.

Teamwork

Once again, teamwork is so obvious and so critical. At the foundation of our team is a close liaison with the chief officers of the county police, fire and EMS organizations. I meet with each group monthly to provide updates and to receive their feedback on system performance. My operations deputy meets with dispatch supervisors weekly. The contractors are in the loop with daily individual contact and a weekly progress meeting with minutes and action items, so we keep focused on the evolving big picture. An outside consulting engineer provides critical technical oversight.

Robust technology

Component failure is a fact of life. Yet single-component failure cannot be permitted to bring down an entire system. Our mitigation approach was the use of robust and redundant systems all the way from dedicated back-up generators through inherent system back-ups that are regularly exercised to alternate systems such as pagers and mobile data systems. The back-ups may not be as elegant as the main system, but they ensure the provision of emergency service to citizens in need.

Training

One of our most challenging, yet ultimately most fulfilling, activities was training. When an organization was ready to make the switch to the new system, the county conducted as much training as the chief officer desired. The goal was to ensure that the organization was ready for the migration from basic, separate-system radios to the feature-rich environment of a trunked, simulcast, interdisciplinary system. We offer follow-up continuation training, and we have provided every chief officer with radio lesson plans for use in annual training.

Among the numerous elements that shape successful communications, these basics seem to have had the most effect on our project. ■

Atkins is director of the Chester County Department of Emergency Services in West Chester, PA.

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CIRCLE (9) ON FAST FACT CARD

Intermod: Getting the upper hand (Part 2)

By Harold Kinley

"An ounce of prevention is worth a pound of cure" certainly applies to the problem of intermodulation interference. Several methods are used to get the upper hand on intermodulation interference. The method used to suppress the IM will depend on where the IM is generated.

Figure 1 shows an RF amplifier with two signals (*A* and *B*) applied to the input. Third-order intermod signals, $2A - B$ and $2B - A$, will appear at the output of the amplifier. Other products will appear at the output as well. However, this discussion will be limited to the third-order IM products. The level of the third-order IM products at the amplifier output will depend on the level of the *A* and *B* signals at the input and the third-order intercept point (TOIP) of the amplifier.

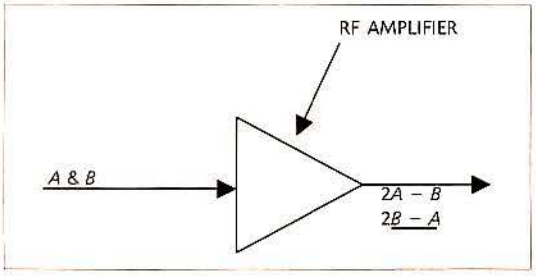

Figure 1: If two input signals, *A* and *B*, are applied to the input of an amplifier, the mixing process would produce two intermodulation products, $2A - B$ and $2B - A$. The level of the IM products at the output of the amplifier will depend on the levels of *A* and *B* at the input and the third-order intercept point of the amplifier. The TOIP is a theoretical figure and one used to quantify the intermodulation rejection ability of the amplifier. The higher this figure, the greater the intermod rejection capability of the amplifier.

Table 1: The relationship of the *A* and *B* input signal levels, the third-order intercept point and the intermod levels at the amplifier output.

Column	A	B	C	D	E	F	G
TOIP	+5	+10	+20	+20	+20	+20	+20
A	−10	−10	−10	−13	−9	+10	+20
B	−10	−10	−10	−13	−9	+10	+20
2A−B	−40	−50	−70	−79	−67	−10	+20
2B−A	−40	−50	−70	−79	−67	−10	+20

Table 1 illustrates the relationship between input levels: the TOIP and IM levels at the amplifier output. In column A, the amplifier's TOIP is +5dBm. This is a low-quality amplifier. Column A further indicates that if the input levels are at −10dBm, the IM levels at the amplifier output are at −40dBm. In column B, the input levels are the same as column A; but, the TOIP of the amplifier is +10dBm and the IM levels at the amplifier output have dropped to −50dBm. Note that the *drop* in the IM level is equal to *twice* the amount of the *increase* in the TOIP. In column C, the TOIP increases by 10dB over column B and the IM level in column C drops by 20dB.

This illustrates the importance of using an amplifier with a high TOIP. Amplifiers with TOIPs much higher than this are used in situations where greater IM suppression is a must. However, these higher-quality amplifiers are accompanied by a higher price tag. It's still true—you don't get something for nothing. Install a cheap amplifier in front of a receiver in a densely populated site, and you will hear things you have never heard before—and wish you wouldn't hear.

If you are lucky enough to have a site where an amplifier can help, then use the highest quality available. Though you might get away with using a lower-quality amplifier today, you probably won't for long.

Refer again to Table 1. Column D shows the two input signals at −13dBm. That is 3dB down from column C. Yet, the output levels of the IM signals are 9dB down from column C. Thus, we have realized a three-fold reduction in the IM signal level compared to the input signals. This is a characteristic of the IM mixing process. For third-order IM, a reduction of 1dB in each of the input signals (*A* and *B*) causes a drop of 3dB in the IM signals. So, for third-order IM we get a three-for-one advantage. That is, for every decibel of attenuation in the input signals, we get a 3dB reduction in the IM product. With fifth-order products, we get a five-for-one reduction. This can be generalized as such: A reduction of 1dB to the intermod-forming input signals will yield *N* decibels of reduction to IM signal for an *N*th-order IM signal. This reduction must occur ahead of the mixing point. This is an important characteristic—one that can be used to our advantage in suppressing IM levels.

In Table 1, examine column E. Here, the input signal levels are increased by 1dB compared to column C (from −10 to −9dBm). Yet, the IM signals at the output have increased by 3dB. This is the reverse of the above situation where the input signals were reduced. This still complies with the IM mixing rules. A change in the levels of the IM forming signals ahead of the mixing point will result in a greater change in the IM signal by an amount equal to the order of the

Contributing editor Kinley, *MRT's* technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, with Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewylde Drive, Spartanburg, SC 29301. His email address is *halkinley@charter.net*.

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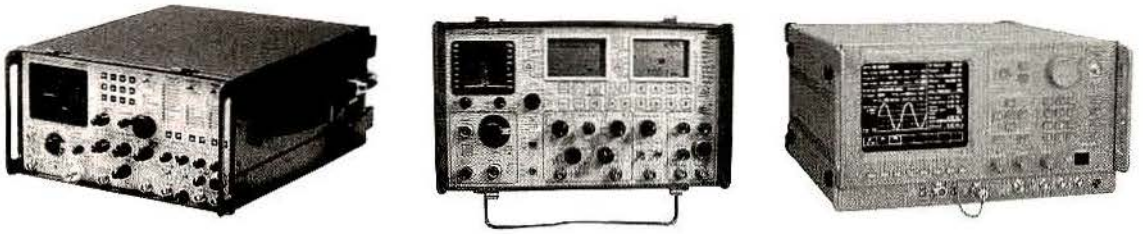

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CIRCLE (10) ON FAST FACT CARD

IM signal.

Taking a final look at Table 1, examine column G. Here, the input signals are equal to the TOIP of the amplifier and the IM signals are equal to the input signal levels. This theoretical point can never be reached in practice because the amplifier would become practically inoperative before this point is reached.

Transmitter-produced IM

The class C output stage of a transmitter is fertile ground for the production of intermod. By design, it is non-linear, rich in harmonics and connected to an antenna. Let's look at a typical two-signal IM product of the third order that is capable of interfering with a nearby receiver. We will assign some frequencies and calculate an approximate level for the IM signal. Then we will apply some solutions and check the final outcome.

Figure 2 shows two transmitters: *A* and *B*. Receiver *C* is operating at a frequency that is equal to $2A - B$. The signal from transmitter *B* enters the final stage of transmitter *A* where it mixes with the signal *A* to form the $2A - B$ IM signal. This is on the frequency of receiver *C* and therefore causes interference to the receiver. The calculation of the level of the IM signal is shown at the right. Because the level of the IM signal is −79dBm, it will seriously degrade the performance of the receiver. Steps must be taken to suppress the IM signal to a non-interfering level. The amount of suppression necessary will depend on the site noise level and the minimum necessary receive level.

Figure 3 shows that to suppress the IM signal to a non-interfering level, a bandpass cavity filter and an isolator have been installed on transmitter *A* where the IM signal is produced. Figure 4 shows the selectivity curve of the bandpass filter. Note that as the signal from transmitter B passes through the filter, it is attenuated by 20dB. The isolator offers another 35dB of attenuation to signal *B* before it reaches the final amplifier stage of transmitter *A*.

Still, an IM signal is formed in transmitter *A* and travels back up the line through the isolator with negligible attenuation. But in passing back through the bandpass cavity filter, the IM signal is attenuated by 20dB. This means that the IM signal leaving the antenna and reaching receiver *C* is 75dB down from what it was before the isolator and cavity filter were installed.

In this case, we did not gain any leverage in reducing the IM signal. To realize any leverage, both signals, or at least the signal with the

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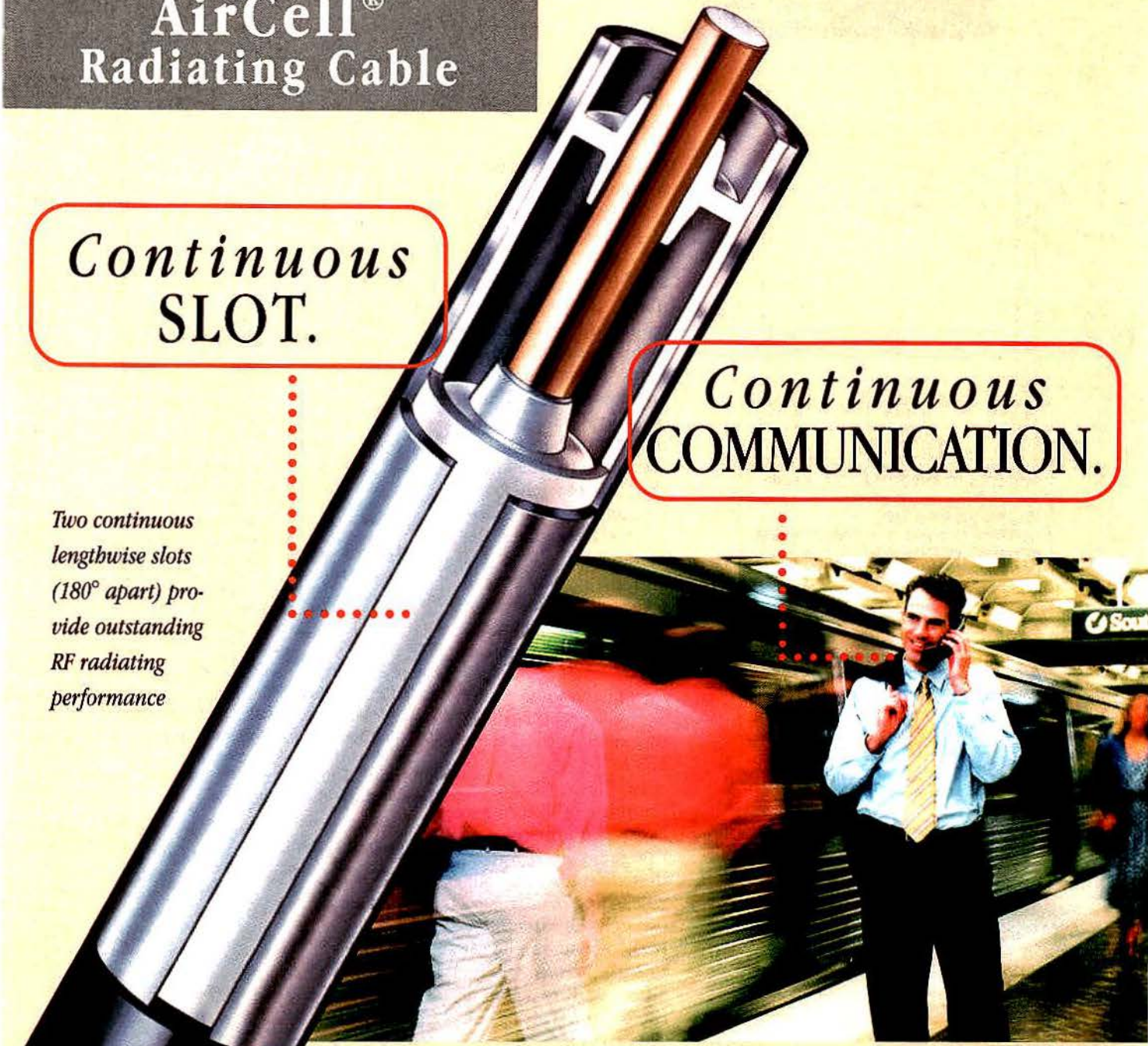

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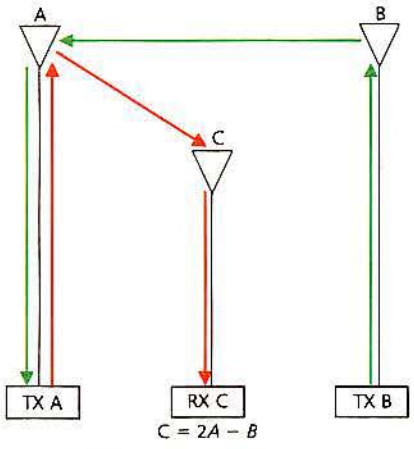

Figure 2: The signal from TX *B* (shown in green) enters the final stage of TX *A*, where it mixes with the signal from TX *A* to form the intermod signal, $2A - B$ (shown in red). This IM signal, at the frequency of RX *C*, causes interference to RX *C*. The IM level at the input of RX *C* is −79dBm. See below for calculations.

TRANSMITTER B	+50dBM
LINE LOSS B	−02
ANT. GAIN B	+06
PATH LOSS ANT. B TO A	−80
ANT. GAIN A	+06
LINE LOSS A	−02
CONVERSION LOSS TX A	−15
LINE LOSS A	−02
ANT. GAIN A	+06
PATH LOSS ANT A TO C	−50
ANT. GAIN C	+06
LINE LOSS C	−02
INPUT TO RX C	−79dBM

coefficient greater than one, must pass through some attenuation ahead of the mixing point. Another mixing point that could generate the $2A - B$ IM signal is in transmitter *B*. However, the IM generated there would be at a much lower level because of the leverage effect. This is because the *A* signal would be attenuated by the path loss between the two transmitters. Because this attenuation would be leveraged by a factor of two, the resulting IM signal in transmitter *B* would be of such a low level as to be inconsequential.

Receiver-produced intermod

There is a third point in Figure 2 where the $2A - B$ IM signal could form. It is in the receiver itself. If the receiver front end were sufficiently overloaded, it would become nonlinear and become a good mixing point for the production of IM products. (See Figure 5.) In this situation, it is possible to get leverage from suppressing the IM signals. Remember, if both IM forming signals (*A* and *B*) are attenuated prior to the mixing point, the amount of reduction in the IM level is leveraged by a factor equal to the sum of the coefficients of the individual signals, *A* and *B*.

In Figure 6, an attenuator is placed between the antenna and the receiver input so that the individual signals, *A* and *B*, must pass through the attenuator. If the attenuator is set to 3dB, then we will realize a 9dB reduction in the $2A - B$ IM signal. This gives us real leverage in dealing with the IM problem. Because the desired signal must also pass through the attenuator, it will also be attenuated by 3dB. So the net gain, in terms of carrier-to-interference ratio, will be 6dB. In a situation where the IM is of low amplitude and the site noise is high, a simple resistive attenuator might be all that is needed to resolve the problem.

Usually, the cure is not that simple. It becomes a matter of selectivity ahead of the receiver. The more selectivity that exists ahead of the first *active* receiver stage, the better is the IM rejection capability of the receiver. It may be necessary to connect two or three bandpass cavity filters in cascade to achieve sufficient suppression of the IM signal. (See Figure 7.) This bandpass response curve represents a bandpass filter arrangement placed in front of the

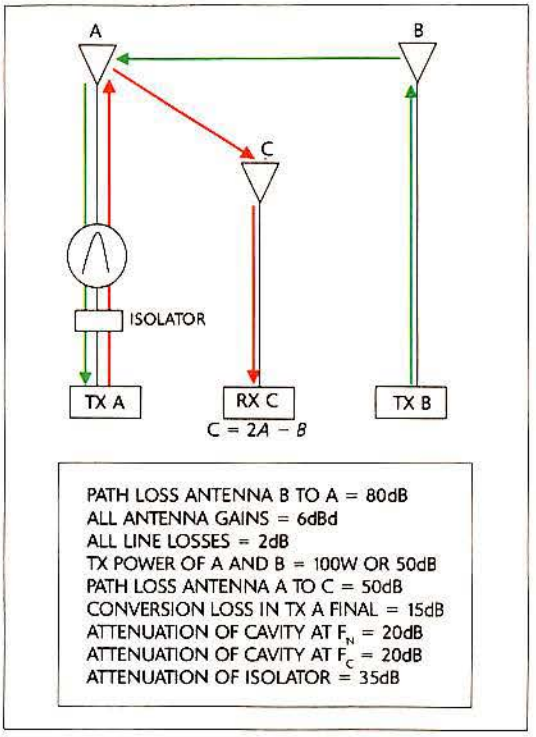

Figure 3: An isolator and a bandpass cavity have been added in the line at TX *A*. This provides an additional 75dB of suppression of the intermod signal. This places the intermod signal at the input of RX *C* at a level of −154dBm. This is well below the receiver sensitivity threshold. Thus, the IM is dead and buried. See below for the calculations.

TRANSMITTER B	+50dBM
LINE LOSS B	−02
ANT. GAIN B	+06
PATH LOSS ANT. B TO A	−80
ANT. GAIN A	+06
LINE LOSS A	−02
CONVERSION LOSS TX A	−15
LINE LOSS A	−02
ANT. GAIN A	+06
PATH LOSS ANT A TO C	−50
ANT. GAIN C	+06
LINE LOSS C	−02
CAVITY ATTENUATION TX B	−20
ISOLATOR ATTENUATION	−35
CAVITY ATTENUATION TO IM	−20
INPUT TO RX C	−154dBM

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receiver. The response of the filter is such that the attenuation at the desired receiver frequency (154MHz) is 2dB. The attenuation at frequency *A* (155MHz) is 10dB. This will be leveraged by a factor of two from the IM form of $2A - B$. The attenuation at frequency *B* (156MHz) is 25dB. Thus the total reduction in the IM signal in the receiver is:

$$2(10) + 25 = 45\text{dB}$$

Another possible filter method uses a notch filter. If it is desired to notch out both signals, *A* and *B*, two notch filters would be required. If we can only use a single notch filter, we have to choose which of the two IM-forming signals to notch. It would be best to notch out the *A* signal (155MHz) because a leverage factor of two would be realized. If we choose to notch out the *B* signal (156MHz) no leverage would be realized and we would only achieve a decibel for decibel reduction in the IM signal. To notch out both of these signals would require two notch cavities.

The advantage of using notch cavities is that more attenuation (at a specific frequency close to the desired frequency) can be achieved than with bandpass cavities. The disadvantage is that the notch filter only helps at one frequency while the bandpass filter helps at many frequencies outside the passband of the filter. The choice of which type of filter to use will depend on the degree of suppression needed and the spacing relative to the desired receive signal.

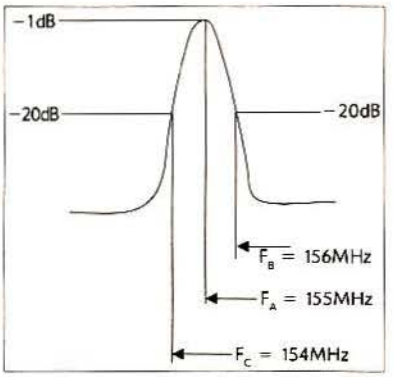

Figure 4: A cavity filter with this selectivity characteristic is placed in the TX *A* line. The center frequency at 155MHz passes the normal TX *A* signal with little attenuation. The attenuation at the frequency of TX *B* is 20dB, and the attenuation at RX *C* frequency (the intermod signal) is 20dB. So, this filter provides dual action to suppress the IM signal.

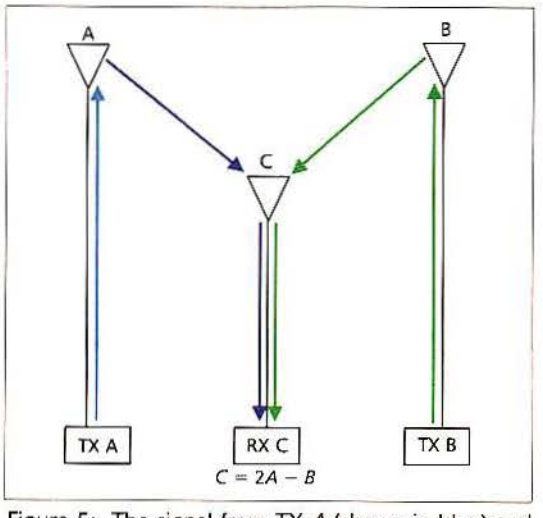

Figure 5: The signal from TX *A* (shown in blue) and the signal from TX *B* (shown in green) enter the front end of RX *C* where they mix to form the intermod signal, $2A - B$. This IM signal, at the frequency of RX *C*, causes severe interference to RX *C*.

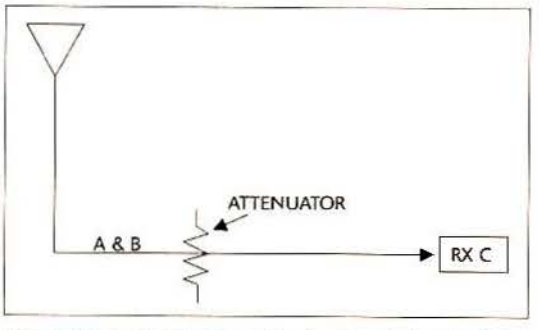

Figure 6: A simple attenuator is placed ahead of the receiver so that the *A* and *B* signals must pass through it before getting into the receiver. This simple attenuator can provide leverage in suppressing the IM signal.

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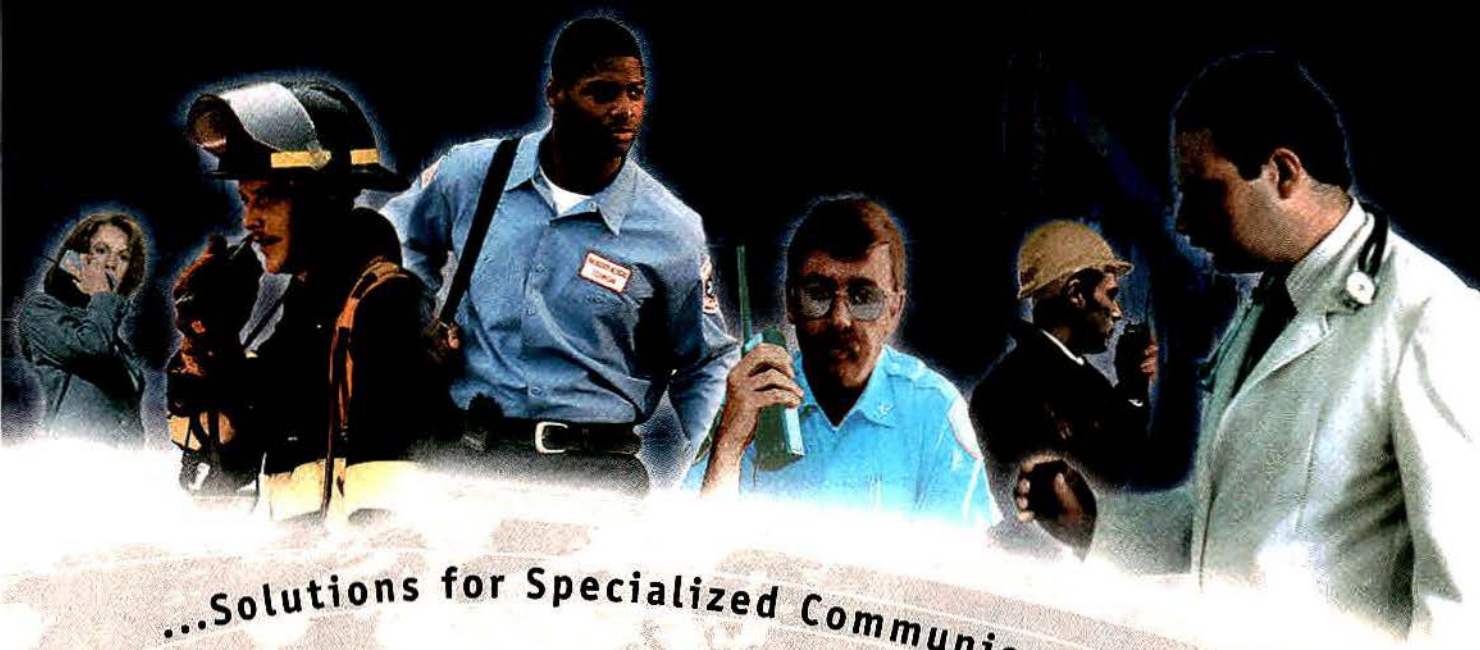

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Crystal filters are now available for operation at VHF highband range and can provide excellent selectivity. Typically, the crystal filter has a comparatively high insertion loss at the desired pass frequency. Some IM generation is also inherent in crystal filters, but the good usually outweighs the bad, yielding a positive net result.

Many times interference is called intermod when it really isn't intermod. Spurious signals are not always the result of intermodulation. One telltale sign of intermod is a signal that might be heard in the middle of a conversation then cut off abruptly. Another sign is an over-deviated signal. The key to suppressing the IM signal is identifying the mixing point and the individual component signals that form the IM. It is possible to have a combination of mixing points. For example, there might be a combination of transmitter-produced IM and receiver-produced IM. When suppression techniques are applied to the transmitter, the results might first appear promising. Then, further efforts might not yield further results. If the IM from the transmitter is suppressed below the level of the IM produced in the receiver, the receiver-produced IM will become the dominant IM and suppression techniques must be applied at the receiver.

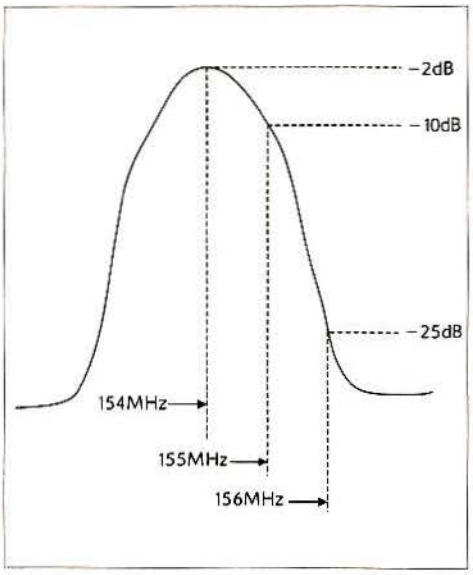

Figure 7: Two or three bandpass cavities connected in cascade could provide a bandpass selectivity such as this to suppress the IM signal level in the receiver. Note that the normal receiver frequency is placed in the center of the passband of the filter to offer little attenuation to the desired signal. The *A* signal is attenuated by 10dB and this will be leveraged by a factor of two while the *B* signal is attenuated by 25dB. This results in a 45dB reduction in the IM signal produced in the receiver.

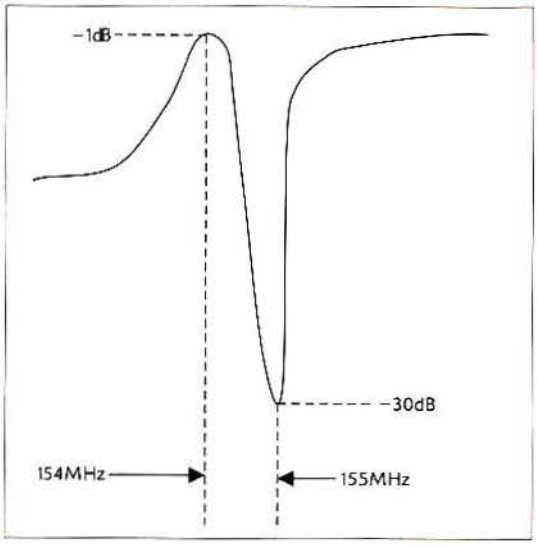

Figure 8: A notch filter such as this can be used to suppress the IM signal. The desired receiver signal at 154MHz is attenuated only 1dB, while the *A* signal at 155MHz is attenuated by 30dB. This 30dB is leveraged by a factor of two so the result is a 60dB reduction in the IM signal.

For further reading, I highly recommend *Intermod Control* by William F. Lieske Sr., founder and retired president of EMR. I consider it the definitive work on intermodulation interference.

Until next time—*stay tuned!* ■

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Olympic glory

Utah police, fire and EMS worked years in advance to ensure a successful and secure Winter Olympics. One critical key was the emphasis on quality communications.

By James Careless

From a public safety standpoint, any Olympics is a logistical nightmare. But with the horrors of Sept. 11 weighing on their minds, Utah police, fire and EMS could be forgiven for being very, very nervous last February.

Well, nervous they may have been, but they were also prepared.

In fact, public safety radio communications for the Salt Lake City Games were so well organized and implemented that the games themselves were "anticlimactic" for the agencies involved, said Gary Lancaster, assistant director of the Valley Emergency Communications Center. The center is a nine-county regional network that helped manage emergency services for the Winter Games.

"It was quite calm during the Olympics," Lancaster said. "We didn't see the call volumes that we expected, and our staff spent a lot of time waiting around for things to happen."

Compatibility and cooperation

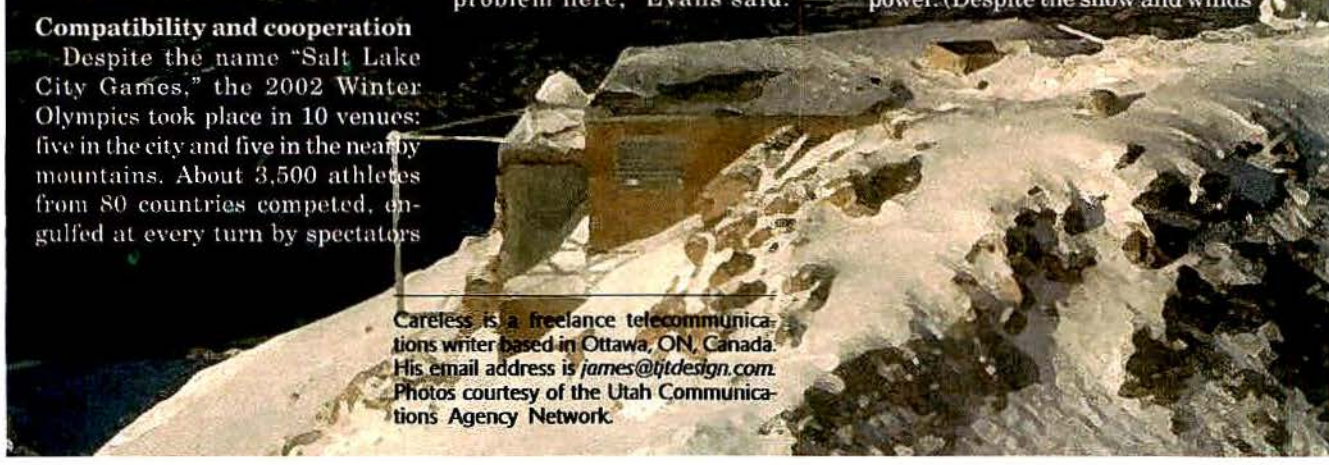
Despite the name "Salt Lake City Games," the 2002 Winter Olympics took place in 10 venues: five in the city and five in the nearby mountains. About 3,500 athletes from 80 countries competed, engulfed at every turn by spectators and media alike.

From a radio standpoint, Salt Lake City proper wasn't a problem. "We have a single, highly placed repeater that provides excellent coverage," said Jerry Evans, communications director of the Salt Lake City Fire Department (SLCFD), which also handles the city's EMS radio traffic.

In concert with county and city police, the SLCFD handled in-town communications from its own dispatch center. SLC police and fire operate on Motorola Centracom Gold Elite Radio systems on 800MHz. "There's no interoperability problem here," Evans said.

However, the mountain venues were something else. To communicate at these games, VECC banded with the Utah Central Area Network—a wide-area network that will eventually deliver state-wide communications—to add 12 extra transmitters and towers to UCAN's existing 43-tower network. (Sixteen separate E9-1-1 centers tied into UCAN, the largest being VECC. All told, UCAN supported 15,600 radios during the Winter Games.)

For maximum range, most of the transmitters were built on mountaintops, said Steve Proctor, UCAN's executive director, with one remote unit running on solar power. (Despite the snow and winds



Careless is a freelance telecommunications writer based in Ottawa, ON, Canada. His email address is *james@tjtdesign.com*.
Photos courtesy of the Utah Communications Agency Network.

that blasted these locations, all stood up well during the Games.)

Like the SLCFD, VECC and UCAN operate on the 800MHz band, using Motorola SmartZone digital equipment. "Five years ago, Utah's agencies were on a mix of UHF and VHF systems," Lancaster said. "However, by the time the Games arrived, we were all operating on 800MHz."

This compatibility was no coincidence, Proctor said. "Five years ago, the Salt Lake City Olympic Organizing Committee realized the wisdom of helping us integrate our mobile radio systems. We negotiated for them to buy the necessary equipment with the understanding that once the Games were over, we'd get to keep it."

The Olympics also helped Salt Lake City get the grant it needed to upgrade to 800MHz. "Compared to the old VHF system, the 800MHz coverage is quite good," Evans said. "Of course, it doesn't perform as well inside buildings or basements, but that's a general characteristic of this bandwidth."

The spectre of Sept. 11

Even before Sept. 11, radio communications for the Salt Lake City Games were being planned with extreme care.

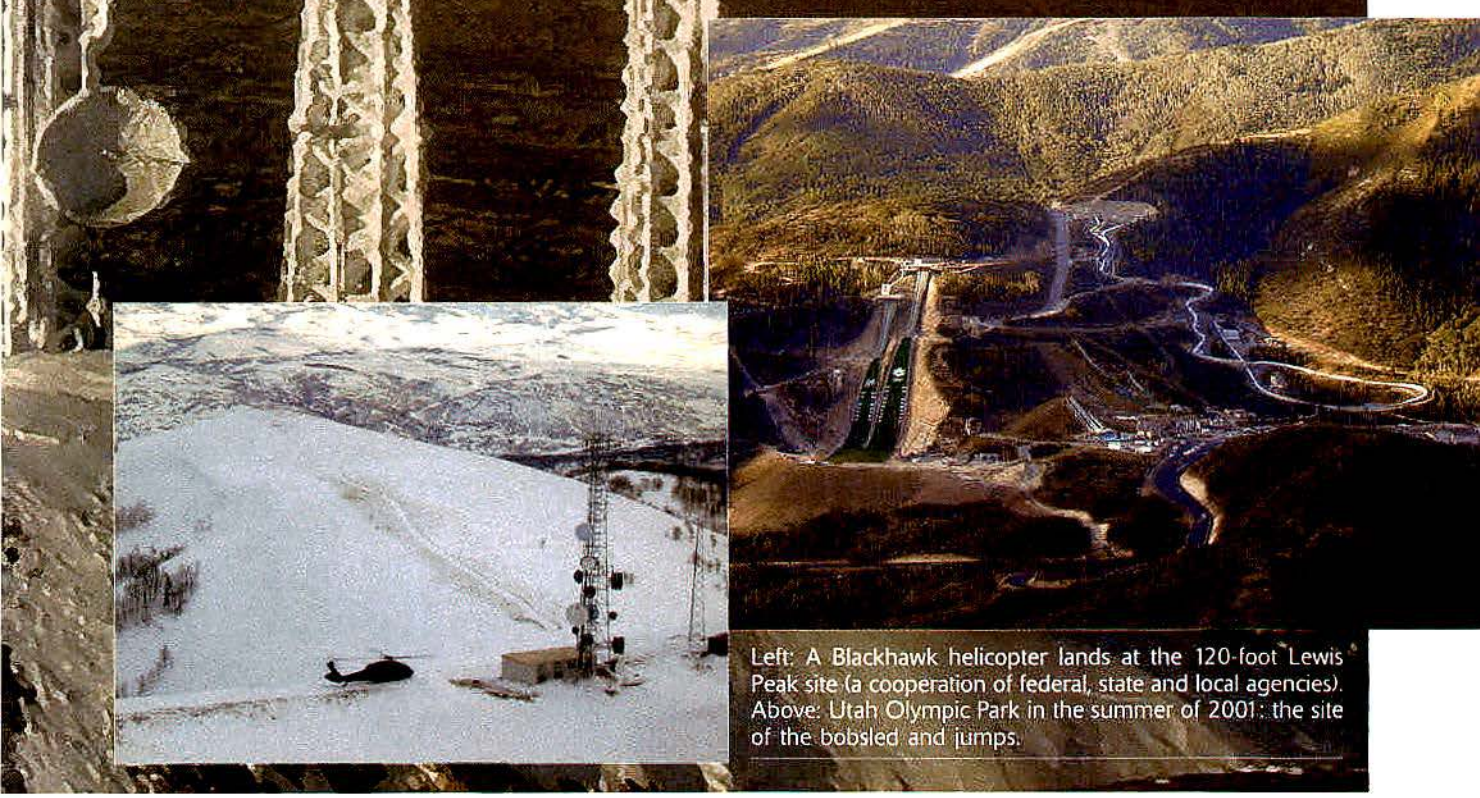
"We set up extra radio channels dedicated to the Olympics, with extra dispatchers and call-takers assigned to manage them," Evans said. "As well, for the Games proper, every single person was scheduled for duty. Nobody was off, except for sickness."

VECC and UCAN did the same, bringing in extra staff who manned extra stations, using extra phone lines and radios.

GlobalStar lent a number of satellite phones to the event, while the Public Safety Wireless Network provided switches to help incompatible agencies link seamlessly to UCAN. Finally, Pierce Manufacturing lent six radio-equipped fire engines to the SLCFD.

At the venues themselves, security was boosted by bicycle teams—equipped with radios and medical kits—and 'gators.' "These are the small golf carts that you see at football games," Evans said. "Equipped with a stretcher, the gators can cart people out of the venues to curbside, where they can be picked up by ambulances."

Left: The Mt. Ogden communications site after the first major snowstorm—the Downhill and Super G events location.



Left: A Blackhawk helicopter lands at the 120-foot Lewis Peak site (a cooperation of federal, state and local agencies). Above: Utah Olympic Park in the summer of 2001: the site of the bobsled and jumps.

Five communications trailers are being installed with equipment for the venues.

Of course, security kept a close eye on these crews. They also thoroughly searched any police, fire and EMS equipment coming onsite, which is why local agencies began to use 'sanitized vehicles.'

"These were trucks and cars which had been pre-checked and approved," Evans said. "Each had a sticker on the window proclaiming this status, and each was generally reserved for Olympic use only. As a result, the crews would just check our undercarriages for bombs, but otherwise let us in without delay."

Sept. 11 motivated the officials to check "the little things, like making sure all of the payphones were working properly, and that the correct location information was coming back to our dispatch center whenever they called in," Lancaster said.

This said, Sept. 11's actual effect was a call to verify the existing plans' soundness. In fact, no major changes

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CIRCLE (19) ON FAST FACT CARD

were made after the Sept. 11 review, Evans said, except for the police receiving a lot of extra radios from the Secret Service and the FBI.

Showtime

On Feb. 8, 2002, the XIX Winter Olympics began in earnest in Salt Lake City. So did the work of the region's public safety networks.

Needless to say, Lancaster's staff was excited. With the years of preparation and fears of terrorism who could say what was going to happen?

Fortunately, not much.

There was a lot of traffic. "Between Feb. 4 and 20, we processed 8.5 millions calls," Proctor said. But the extra staff was able to cope with them. Meanwhile, the 800MHz technology held up fine."There were no major system component failures," Proctor said.

For their part, the bicycle and gator brigades were so efficient that they ended up doing a lot of first-response work, even though the Olympics had hired staff to do this job.

The kinds of incidents were mainly the kinds you'd expect at 4,390 feet above sea level, Evans said: "dizziness and shortness of breath, and things like that." However, there wasn't the level of heart attacks that EMS crews had expected due to altitude, nor any of the other awful possibilities that everyone feared.

In fact, the actual Winter Games were almost a letdown, as far as public safety networks were concerned. That's a reflection of how smoothly things went, and how well the security system performed.

This is a good thing, when you think of it.

Aftermath

Today, Utah's police, fire, and EMS are recuperating from two weeks' worth of global scrutiny.

They've already returned their loaner radios, although Jerry Evans does hope to keep some GlobalStar handsets. Meanwhile, the FBI, Secret Service, and FEMA have pulled out, as have the spectators and TV networks. Once again, life has returned to normal in Salt Lake City.

In hindsight, "The cooperative effort between agencies was marvelous," said Proctor. As for the network performance? Unlike SLCFD, "we found the 800MHz coverage is better than UHF or VHF."

Clearly, when it came to Olympic public safety networks, Salt Lake City got it right.

The key to its success was to "start planning early, and get everyone involved," Proctor said. "The more you cooperate with each other, and the earlier you do so, the more time you have to recognize challenges and address them."

"As well, be flexible," he added. "And remember: Not everyone needs to be in the same talk group." ■

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SS-12	10	12	1⅞ x 6 x 9	3.4
SS-18	15	18	1⅞ x 6 x 9	3.6
SS-25	20	25	2⅞ x 7 x 9⅝	4.2
SS-30	25	30	3¾ x 7 x 9⅝	5.0

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MODEL	CONT. (Amps)	ICS	SIZE (inches)	Wt.(lbs.)
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SS-30M*	25	30	3¾ x 7 x 9⅝	5.0

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MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-10	7	10	3½ x 19 x 9⅝	4.3
SRM-12	10	12	3½ x 19 x 9⅝	4.7
SRM-18	15	18	3½ x 19 x 9⅝	5.0
SRM-25	20	25	3½ x 19 x 9⅝	6.5
SRM-30	25	30	3½ x 19 x 9⅝	7.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-25M	20	25	3½ x 19 x 9⅝	6.5
SRM-30M	25	30	3½ x 19 x 9⅝	7.0

MODEL SRM-30M-2

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MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-25-2	20	25	3½ x 19 x 9⅝	10.5
SRM-30-2	25	30	3½ x 19 x 9⅝	11.0

WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-25M-2	20	25	3½ x 19 x 9⅝	10.5
SRM-30M-2	25	30	3½ x 19 x 9⅝	11.0

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SS-10MG, SS-12MG
SS-101F, SS-121F
SS-10TK
SS-12TK OR SS-18TK
SS-10SM/GTX
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX
SS-10RA
SS-12RA
SS-18RA
SS-10SMU, SS-12SMU, SS-18SMU
SS-10V, SS-12V, SS-18V

CIRCLE (21) ON FAST FACT CARD

*ICS – Intermittent Communication Service

Are they giving customers what they want?

Although recent survey results uncover areas ripe for improvement, they also disclose points of customer approval that offer encouragement to two-way radio makers.

By Stuart Carlaw

One age-old question that all companies ask themselves is: "Are we giving our customers what they want?"

This question forms the bedrock of Intex Management Services' latest research project into the perceptions of mobile radio users and purchasers in North America. This independent survey suggests that for some companies the answer would be "very nearly," and for others it would be a resounding "no." The only universal conclusion is that no supplier is perceived to give its customers entirely what they need.

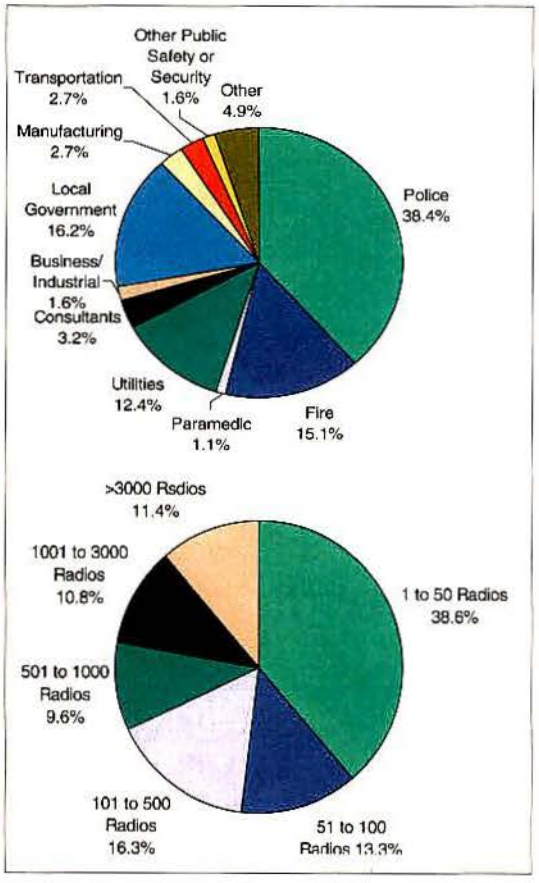


Figure 1. Breakdown of respondents by industry sector and company size. Source: IMS.

IMS sent a detailed questionnaire to 5,000 people in North America involved in the purchasing and use of mobile radio products. From this mailing, a detailed database of responses was compiled. A breakdown of the industry sectors and organization sizes of the respondents appears in Figure 1.

The survey confirmed Motorola's dominant market position. The company was perceived to be the best manufacturer of both terminals and infrastructure. (Terminals include mobile and hand-held radio transceivers.) However, the sky is not entirely dark for all the other manufacturers. The survey identified several chinks in the Motorola armor where users clearly perceived that the manufacturer was underperforming. Figure 2 presents the best-perceived terminal manufacturers in the survey.

If Motorola were to look over its shoulder in the race for the North American mobile radio market, it would most likely see Kenwood Communications. Kenwood had consistently good results for infrastructure and terminals and was particularly strong in competitive pricing and product quality.

The surprise package of the survey must be Vertex Standard, which edged out M/A-Com Wireless Systems for third place. Vertex Standard had a good perceived performance level in most areas—particularly on the technical side.

Surprisingly, considering its large market share, M/A-Com took fourth place. Even more worrisome for M/A-Com must be the fact that

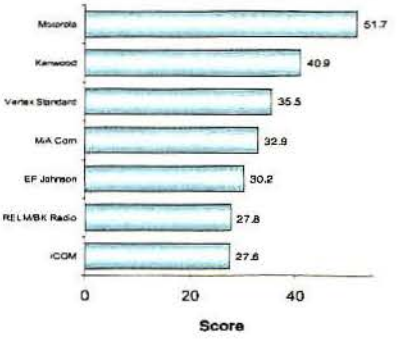


Figure 2. A ranking of "the perceived best overall mobile radio terminal manufacturer" responses.

it performed markedly worse in the infrastructure rankings. It is possible that recent name and ownership changes have affected its performance or have created doubts in the minds of users and purchasers.

The survey led to several fundamental conclusions, including:

- Every major manufacturer was perceived to have one or more key weaknesses.
- There seemed to be specific areas where smaller manufacturers and distributors had a distinct advantage over the larger suppliers.

Carlaw is a market analyst for the Communications Research Group at Intex Management Services, Wellingborough, United Kingdom. The report described in this article is a small part of the IMS mobile radio report portfolio. Carlaw can be reached by email at *stuart.carlaw@imsresearch.com* or by telephone at +44 1933 402 255.

As well as measuring the perceived performance of suppliers, the research also measured the importance of various service-, product- and company-related factors when buyers purchase mobile radios.

This part of the report found that companies and organizations of different sizes and from different industry sectors required strikingly different things from their mobile radio products and suppliers. The most interesting fact was a distinct correlation between the size of the organization and the single most influential criterion affecting the purchase of mobile radio products. Figure 3 compares company size and the importance of two of the main factors measured. For this figure, only "competitive price" and "high product quality" are shown because these were identified as the two major factors for companies of all sizes. ■

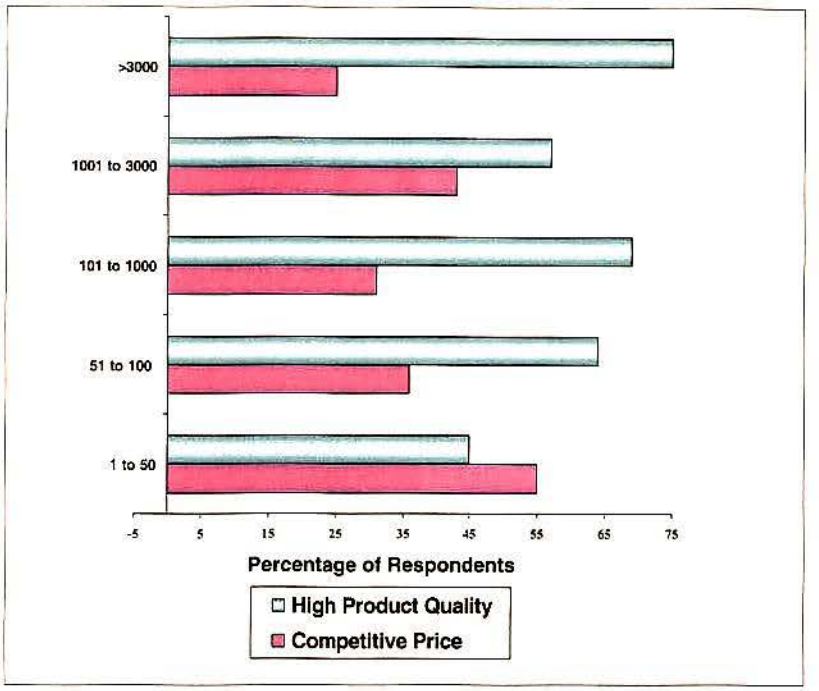


Figure 3. Importance of factors when purchasing mobile radios vs. company size in terms of radios used.

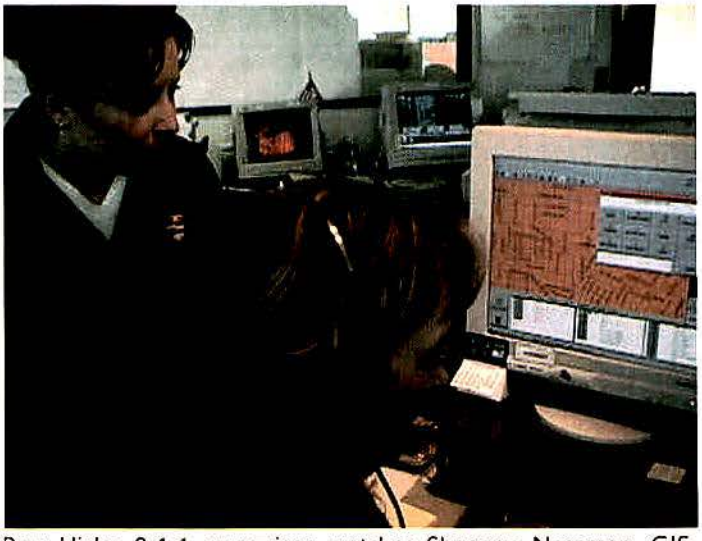
starting small

A rural carrier, two vendors and the Oregon emergency management office teamed to launch what may be the first Phase II wireless E9-1-1 installation on the West Coast.

By Don Bishop

Edge Wireless has become the first wireless telephone carrier on the West Coast to offer GPS-enabled phones for Phase II wireless E9-1-1 service.

Nokia 5100, 6100, and 7100 series wireless phones used on the Edge Wireless system are fitted with an accessory that combines a battery and a GPS receiver. The GPS accessory sends location information to emergency service providers when users dial 9-1-1 and press the "Push-to-pinpoint" button. Location technology providers Airbiquity and Plant Equipment worked with Edge Wireless and the Oregon Office of Emergency Management to activate the service in Douglas County, OR, in April. Service to Josephine, Curry and Coos counties was slated to follow in June.



Pam Hicks, 9-1-1 supervisor, watches Shannon Neseman, GIS coordinator, examine the nearest address to the wireless caller.

Responding to requests from carriers, including Edge Wireless, the FCC granted waivers to extend the Phase II deadline beyond the original Sept. 1, 2001, date. Edge Wireless perceived a marketing advantage, together with improved safety for its customers, and completed its Phase II installation not long after the original deadline. In its rural coverage area, Edge competes with Ramcell, U.S. Cellular, Sprint PCS and Nextel Communications to serve area residents, along with motorists on the busy Interstate 5 corridor.

"In this area, Edge Wireless has broken the ice," said Herb Torrens, manager for corporate communications at Temecula, CA-based Plant Equipment. "When one carrier offers E9-1-1, the rest are motivated. A big reason to have a wireless phone is for safety. The first carrier to have it advertises and promotes it."

Ken Keim, Oregon OEM's section director for technology and response services, added that the four counties include a lot of land but a small population. The GPS accessory avoids the need to use technology installed at cell sites to triangulate, to measure time difference of arrival or to use other methods of calculating a handset's location.

"We're happy to get a Phase II installation working," Keim said. "Plus, this installation gives us a way to prove the mapping technology that we're going to use statewide."

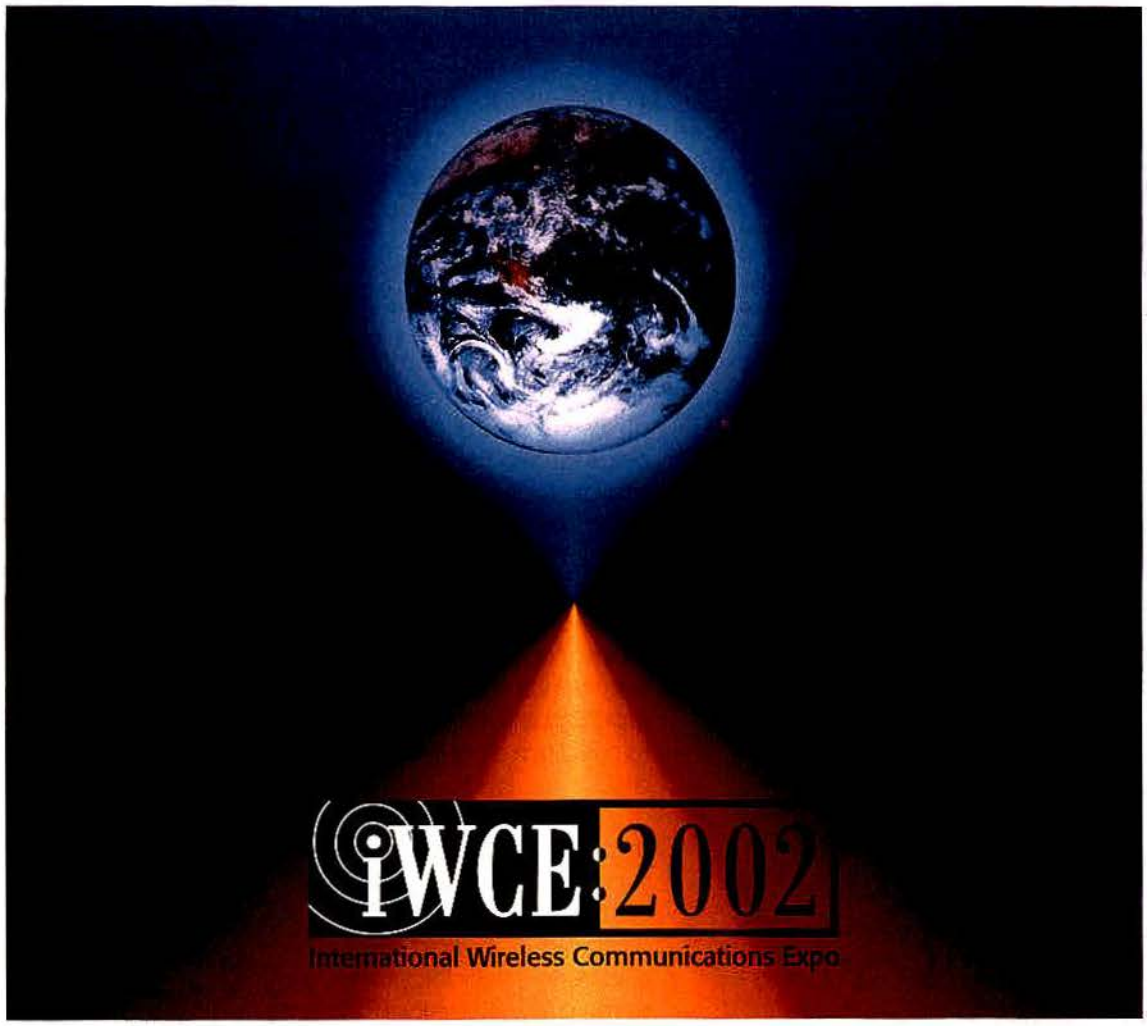
Using digital map information from Tele Atlas North America (formerly Etak), Menlo Park, CA, Keim's team worked with employees at the Douglas County Sheriff's Office Communications Center, a public safety answering point, to develop the master street address guide used to plot location coordinates delivered by wireless carriers. Torrens said that data often must be converted from old-fashioned tabular lists and paper maps to make the digitized map data sets used by a modern geographic information system for E9-1-1.

Plant Equipment's mapping software matches coordinates sent by the GPS accessory over the Edge Wireless network to the PSAP with the nearest address in the street guide. A map pops up on the dispatcher's screen showing the location and identifying it with an address, an intersection or a milepost. The dispatcher reads the information over a voice channel to the responder, unless the responder has a mobile data terminal.

"Edge Wireless brings the telephone call. Airbiquity brings us the latitude and longitude transmitted over the phone line and decodes it at the PSAP with the help of Plant Equipment's mapping products. It

Bishop is editorial director. His email address is *dbishop@primediabusiness.com*.

A Big "Thanks"



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took a lot of equipment and initiative to move this product along to get something out in the field and working," Keim said.

Airbiquity, Bainbridge Island, WA, makes the GPS accessory for the Nokia handsets. The technology requires no modification of the handsets or the TDMA network used by Edge Wireless. Edge Wireless offers the GPS accessory pack for about $60 to $70—much less than the cost of a stand-alone GPS unit and about the same price as a standard battery pack

At the PSAP, Airbiquity's aqServer and Plant Equipment's Vesta (a telecommunications system that integrates computers and telephony) decode the GPS data. Plant Equipment's digital mapping display, Orion MapStar, plots the precise location on the digital mapping display.

Rimkus

Keim said that the state has been working on a timeline since beginning to collect a tax in 1995 to fund wireless E9-1-1, and that the April launch of service in Douglas County was right on time. He said that the implementation might have happened sooner, but it took time to convert all the necessary maps to a digital form.

Keim said that more than 40% of calls to 9-1-1 in Oregon originate on wireless phones, and the percentage is rising. In the four-county area where Edge Wireless is rolling out Phase II service, he said that neither Ramcell Cellular nor U.S. Cellular has reached the level of Phase I service, which identifies which cell site is handling a wireless 9-1-1 call. He said that Sprint PCS and Nextel are in the process of installing Phase I service in the same area.

Andy Rimkus, vice president of marketing at Airbiquity, said the installation is important to the company as one of the first implementations of a GPS handset in the United States. He said that he anticipates that Edge Wireless would follow up with commercial services this year using the same product. Those services include operator-assisted, location-based services using location information

Airbiquity's GPS accessory.

The players

Edge Wireless — An AT&T Wireless affiliate in the western United States, Edge Wireless has been operating in Oregon for less than a year. Jeff Keller, the company's director of operations, noted that Edge Wireless' competitors have been operating there for several years, without achieving Phase II wireless E9-1-1 service. Edge Wireless was formed in 1999 by Wayne Perry, Cal Cannon and Donnie Castleman. The company uses time-division, multiple-access network technology. Joe Gayer, director of strategic relations, heads the company's wireless E9-1-1 team. Gayer has been an officer in state chapters of APCO and NENA.


Gayer

Oregon OEM — By January 2001, the Oregon Office of Emergency Management had updated the state's 57 PSAPs with integrated computer and telephony systems to deliver border-to-border wireline E9-1-1 service. In partnership with state chapters of APCO and NENA, Oregon's 9-1-1 program includes a Phase II wireless location project that features statewide mapping services, an inter-tandem transfer network and database services.

Ken Keim, OEM section director of technology and response services, said that the state is ready to accept location data from carriers and to install the necessary interfaces in minimal time. "There's a lot of frustration on my part and from the rest of the public safety community that carriers aren't moving faster with Phase II," he said. "When the Edge Wireless project came along, we jumped at it. We hope that with the successful completion of this installation, other carriers will be willing to step up and do something."

Plant Equipment — Established in 1968, Plant Equipment made its first product, a key telephone system, for utility industry call centers. The company later developed automatic number identification and automatic location identification systems for 9-1-1 call centers. Today, the company offers an integrated management system for mapping components that allows call centers to build and customize digital master street address guides.

"We developed middleware for our mapping application, and Airbiquity's aqServer that allows the two applications to exchange data, something we would do for any other location technology vendor. Our digital mapping display can accept wireless and wireline data from any type of system whether network- or handset-based," said Herb Torrens, manager of corporate communications at Plant Equipment.

Airbiquity — A location technology company that delivers GPS data to wireless networks, Airbiquity sells patented aqLink software that enables wireless carriers, automobile manufacturers, commercial call centers and Internet portals to offer their subscribers location-based services that enhance productivity, manage assets and deliver personalized content. Among the company's customers are AAA and its Response Services Center subsidiary, the Wingcast joint venture of Ford Motor and Qualcomm, Agere Systems (formerly Lucent Microelectronics) and Security Associates International.

that the customer would transmit voluntarily using the push button. Examples of commercial services include roadside assistance and help in finding the nearest bank or ATM.

"We've proven that there is a solution for TDMA and GSM systems," Rimkus said. "Some have argued that such a solution doesn't exist. I believe we've shown that it does."

Moreover, Rimkus said that the installation is a "proof statement" to the public safety community and a credit to Edge Wireless' leadership.

"Edge Wireless is a small rural carrier, and it has taken a big leadership role when other carriers perhaps have not. They showed that Phase II wireless E9-1-1 can happen today, where others seem to have taken a wait-and-see attitude toward wireless E9-1-1."

Rimkus said that the Airbiquity GPS accessory would work the same with any of Edge Wireless' competing carriers' handsets.

Airbiquity has more rural carriers in its sights. Rimkus said that the FCC tracks 660 wireless carriers, leaving many potential carriers as customers beyond the "Big Six."


Plant Equipment's Vesta mapping software matches coordinates sent by the GPS accessory to the PSAP with the nearest address in the street guide.

"We are targeting those small-to-medium-size carriers that want to solve their 9-1-1 issues, and we have some more coming up," he said. "We think rural carriers are underserved. GPS works well where you can't triangulate easily, such as where cell towers are spread far apart. And a good number of rural carriers still use TDMA where usable Phase II technology is hard to come by." ■

IWCE reflects important industry issues

The International Wireless Communications Expo opened on Wednesday, April 23.

What started out as the National Radio Dealer's Conference in 1977 has evolved to an international wireless conference and exposition. More than 350 exhibitors of land-mobile related equipment and services came to Las Vegas to present their products at the 26th International Wireless Communications Expo. Many exhibitors reported "quality" attendance, as visitors seemed genuinely interested in purchasing equipment.

The conference program reflected the most important issues of the industry today, including the Nextel White Paper, the status of Project 25 equipment, the tower market, update of 220MHz–222MHz, first response at the World Trade Center and FCC "speed traps."

Other special events were also held in conjunction with IWCE. The Small Business in Telecommunications sponsored its annual Jam Session, and PCIA held a workshop for the 21st century radio dealer. IWCE 2003 will take place March 10–14 at the Las Vegas Convention Center.

Kitchen sees opportunities for dealers in spectrum swap

The International Wireless Communications Expo opened April 23 with remarks from keynote speaker Jay Kitchen. Kitchen, chief executive of the Personal Communications Industry Association, said that "the industry is having a hard time these days."

Kitchen

"Much like you, at PCIA we have been challenged," he said. "You've seen the press this week. We've downsized over a year and half." (See related story at **www.mrtmag.com**.)

Kitchen remained optimistic throughout the speech, however, encouraging dealers to listen to their customers and present solutions to specific problems. "I'm still optimistic about wireless and about land mobile radio, which has been around since World War II. The buzz is back in wireless, and it is going to re-emerge. We've learned a lot from the last 18 months in this deep valley we've been in."

Kitchen said that the telecommunications industry had been shaken more by the economy, and not by a lack of technology.

Kitchen also discussed the Nextel proposal, saying that it had been causing "a lot of discomfort in the industry." He sees opportunity if the proposal were implemented. "Relocating frequency blocks to new licensees is not uncommon. Don't forget that's nothing new ... But moving them around so everyone is treated equally is something we need to work on.

"Put your spectrum needs in perspective. How much of your business plan depends on securing spectrum?" He said entrepreneurs should always be looking and not missing an opportunity. He mentioned opportunities such as other spectrum bands (700MHz, 220MHz, and even 450MHz), spectrum build-outs and dispatch.

"Dispatch is a hot business," he said, noting Nextel and Sprint PCS as increasing awareness of dispatch.

Kitchen said that five important things to keep in mind are to watch, listen, look around, learn and act. "The turtle only moves forward when its neck is stuck out." —*NC*

Alexander-JBRO combo forms Lexstar Technologies

Alexander Technologies and JBRO Batteries have merged to form Lexstar Technologies, Lisle, IL. Alexander, a company with 150 employees, had an estimated $38 million in sales in 1995. JBRO, a company with 83 employees, had an estimated $29 million in sales in 1998. Although no recent sales figures are available, a company official said that current revenues for both companies are somewhat less.


Hennig

W.R. "Bill" Hennig, who was named Lexstar's president, had been president and chief executive of Alexander since leaving a similar post in 1999 with Dallas-based A.O. Smith's Water Products Division for what he described as an opportunity to grow Alexander's business.

"We were working on an acquisition strategy last year, but private equity funding dried up after Sept. 11," Hennig said. "Instead, we decided on a merger. Lexstar can grow more quickly than Alexander and JBRO could grow separately."

Based in Mason City, IA, Alexander made batteries, chargers and conditioners for the electronics, medical, security, scanner and military markets. Based in Lisle, IL, JBRO made battery packs for camcorders and two-way radios and had established the Telepower brand of retail products. These products now belong to Lexstar. The unified product lines may improve Lexstar's ability to serve aftermarket buyers and to serve OEM customers compared to the separate companies.

Lexstar's executives said that JBRO's value-added reseller status with Hawker Energy, a supplier of starved electrolyte, sealed lead-acid batteries, would strengthen Alexander's successful medical line; and JBRO's large customer base would benefit from the addition of Alexander's chargers and analyzers.

Hennig said that he expected that the merger would not necessarily change the number of employees, but in eliminating duplicated functions, the location of employment might change.

He said that Lexstar intends to keep the same manufacturer's representatives that have been representing Alexander and JBRO individually. "They are our partners in the marktplace. We will continue with that arrangement. We want to use all the resources available," Hennig said. *–DB*

Non-solder connectors suit field installations

Times Microwave Systems has two non-solder EZ two-piece N type connectors for LMR-900-DB and LMR-900-FR flexible low-loss 5/8" 50Ω coaxial cables. The EZ-900-NMC-2 (male) and EZ-900-NFC-2 (female) connectors use spring-finger center-conductor contacts and clamp-style outer contact attachments. The number of connector parts makes these suitable for field installations. Non-solder EZ style connectors are also available for most LMR cable sizes covering type N, 7/16 DIN and reverse polarity TNC interfaces.

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Connectors available in more varieties

Radio Frequency Systems has added four connectors to its Rapid-Fit single-piece connector line for foam-dielectric coaxial cable. Type N and 7/16 DIN female connectors are available for the Cellflex foam 1¼" cable, and Type N and 7/16 DIN male connectors are available for Cellflex 7/8" cable. These connectors are waterproof to IP68 and have good IM and return-loss characteristics. They attach to the cable as a single piece, minimizing the installation time and errors associated with multipiece designs.

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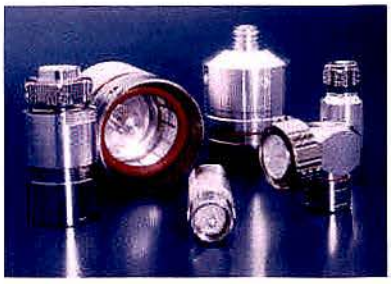
Connectors offer simple installation



NK Cables' one-piece connectors feature silver plating in all electrical contact areas and high-contact mating pressure between the center pin and the center conductor on the cable. Also offering high-contact mating pressure at the connector interface, the connectors ensure low and stable IM performance with good electrical performance. The connectors have met waterproof per IP68 water immersion testing specifications and are available in two sealing technologies: o-ring seal and Plast 2000 sealant injection.

WWW.NKCABLESUSA.COM

Connectors provide 65GHz connection

The integrated V connectors from **Anritsu** incorporate the launcher and integrated glass bead in a single housing to produce improvements in efficiency and performance. The connectors are suited for microwave applications where specified connector performance at frequencies to 65GHz is needed. The V115F is a ground-lip version, which includes all compensation steps for matching to microstrip or coplanar waveguide. It provides a short ground path to help maintain good VSWR at millimeter-wave frequencies. A screw-in version, the V116F, is also available. Both connectors are compatible with existing V connectors, as well as with 2.4mm connectors.

WWW.US.ANRITSU.COM

VoIP console provides 18 control lines

Telex Communications' Vega C-6200 VoIP desktop conventional radio control console with modular dual-line tone card provides as many as 18 control lines. Any line can be configured for a dedicated two- or four-wire full-duplex circuit or E and M (local control keying). The console features programmable squelch control, cross mute (hardwire), paging, instant call recorder and voter steering.

WWW.VEGA-SIGNALING.COM

Product Encore

Antennas hidden inside equipment rack

The Surveillance rack antenna system from **STI-CO Industries** simulates a standard contractor's van rooftop equipment rack. Hidden inside are the antennas. This system offers one antenna per vertical roof stanchion for a total system of as many as six antennas or six bands. The mobile antenna system eliminates the need to mount multiple antennas inside or outside the vehicle and can be installed on any model van. It can be moved from one vehicle to another to support different looks or requirements and provides easy upgrade alternatives.

WWW.STI-CO.COM

Coaxial cable provides low attenuation

Trilogy Communications' 1¼" AirCell transline and radiating coaxial cable is a fully bonded, hermetically sealed, air-dielectric cable. It provides low attenuation and protection against water migration. The cables are lightweight for less tower loading. The transline is for tower applications, and the radiating supports tunnel applications. The outer conductor on the radiating cables is fully bonded and hermetically sealed.

WWW.TRILOGYCOAX.COM

PN scanner covers PCS, cellular frequencies

The Cardinal from **Berkeley Varitronics Systems** is a handheld PN scanner designed to measure PCS and cellular CDMA frequencies for IS-95B and 1XRTT/CDMA 2000 base stations. The dual-band receiver operates both indoors and outdoors, scanning all 512 base stations in less than a second. The scanner derives the base station's system time and ID via its internal sync channel demodulation.

WWW.BVSYSTEMS.COM

Dual-ID encoder sends PTT ANI

The QE-2i module is for plug-in MDC-1200 and GE-STAR ANI applications with Icom radios. The device is a dual-ID encoder, which will send PTT ANI, emergency ANI and man-down ANI transmissions. The model has been tested in the F30GT, F3S-2 and the F3GS-2. It features programmable time-out timer, stuck microphone identification and eight timing sequences for the man-down switch.

WWW.CIMTECHCORP.COM

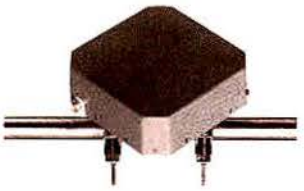
GPS/AVL modems support Kenwood

Kenwood Communications' KGP-2A/2B GPS receiver and modem are ready for use with the 80 series or 60G series Kenwood trunking mobiles. The system is installed in a vehicle, incorporating a built-in modem with microprocessor control for base station and mobile unit coordination. One KGP-2B is used for each base station. The radio connection is provided through conventional and trunking mobiles.

WWW.KENWOOD.NET

Antennas cover dense urban areas

The 721DD65ESXM and 721DD85ESXM from **Decibel Products** are dual-band, diversity polarization antennas for dense urban coverage. They are designed to provide two independent frequency ranges to operate under the same antenna radome. The antennas provide 65° and 85° coverage in independent bands of 1,850MHz–1,990MHz and 806MHz–896MHz. Both antennas feature slant 45° polarization with an engineered dipole structure that is resonant on both bands without the use of a crossband coupler. The antennas are packaged so they can be mounted with connectors up or down, depending on the cell site. They may also be mounted flush to a building face and then painted to blend into the background.



WWW.DECIBELPRODUCTS.COM

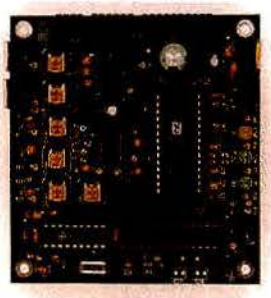
Radiating cable offers flexibility

Times Microwave Systems' FlexRad-600-PVC flexible radiating cable can be used to provide RF coverage in enclosed areas where point source antennas are not practical. These cables offer broadband performance to support a wide range of applications such as mining, in-building communications systems, underground applications or any enclosed area where controlled RF coverage is desired. The design allows the cable to be easily installed without kinking.

WWW.TIMESMICROWAVE.COM

Controller easily programs

The **NHRC**-3+ remote controller offers simplified programming, a CTCSS input, multitone courtesy tones, fan control output, four digital outputs and two courtesy tone select inputs. The controller is programmable by sending DTMF sequences. The CW ID, hang time, timeout timer and tail message counter can all be programmed by the user. All the programming is password-protected and stored in non-volatile EEPROM. The system has a duplex or simplex operating mode.



WWW.NHRC.NET

As our magazine celebrates its 20th year, Steve Lemons takes a look in the rear-view mirror:

Looking back over the past 20 years, I am still amazed at the resilience of the two-way radio shop. Battered with new, competing technologies and fewer new radio products to promote, the radio shop hangs on. Successful shops that maintain a presence in their markets have engaged the wireless giants and have found ways to work with them. And the experienced technical services that they can provide have been a valuable outsource.

Technical competence and experience may prove to be the key ingredients of successful shops.

Earning a livelihood from radio repairs has been offset with new technologies and the engineering of customer solutions. Whether supplying new data transmission backbones or providing new high-tech security systems, the radio shop has been forced to find ways to generate income besides merely replacing a spent power amplifier transistor.

Another obvious change over past years has been the drastic reduction in competing radio lines. In a market that once included more than a dozen reputable logos (and that now is a market pie with only a few slices), a shop's ability to compete on service alone is more important than ever.

My hat is off to the radio shops that have maintained a strong presence and that have held to the standards of quality and customer service. Over the years, I have learned that the quality of a shop's performance is directly proportional to the shop's longevity.

As an aside, I find myself chuckling every time I run into a young enthusiastic wireless tech who has no memory or knowledge of the "base-and-five" market.

—Steve Lemons
National Sales Manager
Radiofrequency Safety International

(Lemons was the editor of Communications *magazine in 1982 and 1983.*

At RSI in Kiowa, KS, he sells the company's professional consulting services and conducts seminars on RF safety and compliance in connection with FCC and OSHA regulations. He can be reached at 620-825-4600 or sl@rfcomply.com.)

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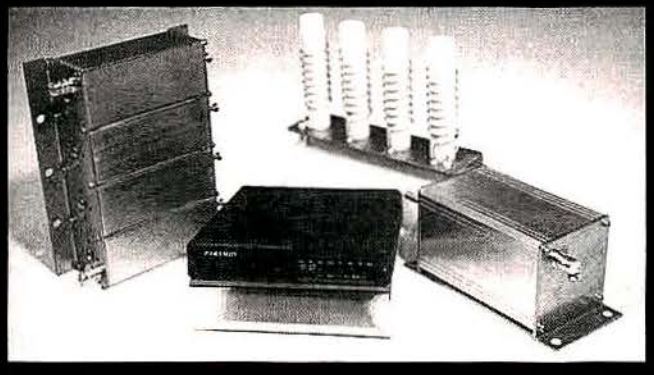

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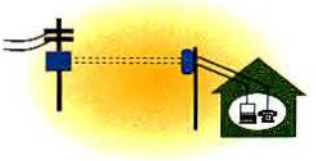

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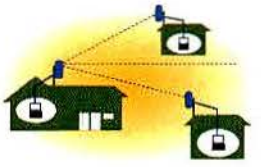

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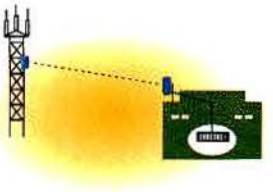

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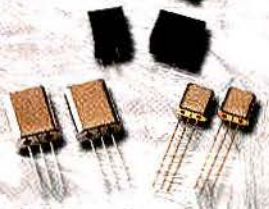

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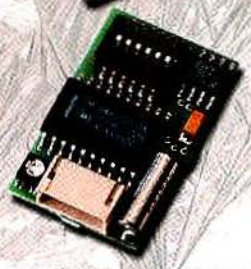

SS-64
CTCSS Encoder
Microminiature, DIP switch programmable.
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